

A NEW SUBSPECIES OF *PENTAGRAMMA TRIANGULARIS* (PTERIDACEAE)

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ABSTRACT

*Pentagramma triangularis* (Kaulfuss) Yatskievych, Windham, & E. Wollenweber subsp. **rebmanii** Winner and M. G. Simpson subsp. nov. is a new subspecies endemic to south-central to southeast San Diego County, California, USA, and inland, northwestern Baja California, Mexico. It is uncommon on seasonally moist, granitic-derived or gabbro-clay substrates, distinguishable from other *Pentagramma triangularis* subspecies by the scattered white farina on the adaxial blade surface and lightly scattered along the stipe.

RESUMEN

*Pentagramma triangularis* (Kaulfuss) Yaskievych, Windham, & E. Wollenweber subsp. **rebmanii** Winner and M. G. Simpson subsp. nov. es una subespecie endémica del centro-sur al sureste del Condado de San Diego, California, Estados Unidos de America, y del interior noreste de Baja California, México. Esta planta poco común crece sobre tierras estacionalmente húmedas derivadas de granito o de gabro, y es distinguible de otras subespecies de *Pentagramma triangularis* por la presencia de farina blanca desparramada en la superficie adaxial de la lámina y ligeramente por todo el estípite.

Key Words: Baja California, Mexico, *Pentagramma*, Pteridaceae, San Diego County, California, USA.

San Diego County, California, has an exceptionally diverse flora for an area of its size, containing 2314 vascular plant taxa; 1735 taxa or 71% of the total are native (Rebman and Simpson 2006). Included among these are 29 taxa (27 species) of leptosporangiate ferns (=Polypodiopsida, *sensu* Smith et al. 2006); 28 of which are native. Thus, the leptosporangiate ferns of San Diego County constitute 1.2% of the total vascular flora and 1.6% of the native vascular flora. The adjacent Baja California peninsula of Mexico constitutes a much larger area and is considerably more diverse, with over 4000 total vascular plant taxa and nearly 30% endemism (Rebman 2006). Of these taxa, 70–75 leptosporangiate ferns (Mickel and Smith 2004) comprise approximately 1.7% of the total vascular flora. A comparable number of leptosporangiate fern taxa (ca. 75) and overall species endemism (30.6%) occurs in the state of California (Hickman 1993).

We describe here a new leptosporangiate fern subspecies, currently known only from south-central to southeastern San Diego County, California, and from inland, northwestern Baja California, Mexico. This new taxon adds to our

knowledge of the biodiversity of these floristically rich regions.

*Pentagramma triangularis* (Kaulfuss) Yatskievych, Windham, & E. Wollenweber subsp. **rebmanii** Winner and M. G. Simpson subsp. nov.—**Type:** USA, SAN DIEGO COUNTY, CALIFORNIA: Cleveland National Forest, Pine Creek Wilderness, north of Barrett Lake and south of Descanso, east of Japatul Valley Road, southeast of Horsethief Canyon Trailhead and just west of Pine Valley Creek, north-facing slope, 32.7442°N, 116.6533°W, 610 m, 23 March 2005, *J. Rebman 11483 and G. Bustillos* (holotype: SD 159328; isotypes: BCMEX, RSA, UC).

**Paratypes** (see Fig. 4 for locality map): USA, SAN DIEGO COUNTY, CALIFORNIA: 8 mi E of Jamul, 0.6 mi E of Lawson Peak, 1 mi NNW of intersection Lyons Valley Road and Carveacre Road, 32.7258°N, 116.7158°W, 29 May 2005, *J. Barth 529* (SD 160835); Cuyamaca Rancho State Park, Descanso quad T15S, R4E, Sweetwater River near Merrigan Falls, 24 March 1986, *M. Curto 254* (SD 121002); Warrens Ranch, Campo, 22 April 1920, *A. Eastwood s.n.*

(CAS 92550, CAS 92554); below Morena Dam, 12 March 1936, *F. Gander* 727 (SD 13923); 3 mi W of Canyon City, 7 April 1936, *F. Gander* 1149 (SD 14364); Hipass, 12 May 1936, *F. Gander* 1875 (SD 15294); La Posta, Old Highway 80, 0.1 mi W of intersection with Miller Valley Road, 32.7112°N, 116.3874°W, 13 February 2005, *J. Gregory* 1251 (SD 160825); La Posta, Old Highway 80, 0.1 mi W of intersection with Miller Valley Road, 32.7112°N, 116.3874°W, 13 February 2005, *J. Gregory* 1252 (SD 160824); Barrett Lake, near W shore on Barrett Lake Road, 3 mi SE of junction with Lyons Valley Road, 32.6823°N, 116.6758°W, 8 May 2007, *J. Gregory* 2321 (SD 175902); Cleveland National Forest, W of Cuyamaca Mountains, ca. 4 mi S of intersection Eagle Peak Road and road to Deadman Flat, 33.0468°N, 116.6813°W, 1 April 2007, *J. Hirshberg* 1361 (SD 175764); along trail below Morena Dam, 12 April 1963, *Larry Kiefer* 511 (CAS 931205); Bratton Valley, 3 mi N of Delzura, 2.5 mi SE of Lyons Valley Peak summit, 0.5 mi S of intersection Honey Springs Road and Deerhorn Valley Road, 32.675°N, 116.7478°W, *J. Maxted* 395 (SD 175857); Tecate Mountain, S side, 32°34.5'N, 116°41'W, 26 April 1969, *R. Moran* 15845 (SD 74734); Cleveland National Forest (Descanso District), 1 mi SE of Lawson Peak, along Carveacre Road, 0.7 mi NW of intersection with Japatul Valley Road, 32.7163°N, 116.711°W, 19 May 2005, *M. Mulligan* 1086 (SD 164908); Cottonwood Creek, 10 May 1924, *P. Munz* 8029 (POM 48058); N base of Tecate Mountain, 15 March 1931, *P. Munz* 11961 (POM 183678, UC 494522); Hauser Canyon Wilderness Area (USFS), N of Hauser Mountain, SW of Morena Lake, NW of Cameron Corners, 32.6714°N, 116.5697°W, 9 May 2003, *J. Rebman* 8919 (SD 157262); Viejas Mountain, N of Alpine, 32.8703°N, 116.7331°W, 17 June 2004, *J. Rebman* 10584 (SD 157261); Walker Canyon Ecological Reserve between Boulevard and Jacumba, N side Interstate 8, near E side of reserve, 32.6622°N, 116.2103°W, 2 December 2004, *J. Rebman* 10766 (SD 157264); Viejas Mountain, N of Alpine, USFS land E of Kelley/Rebman Ranch, 32.8789°N, 116.7317°W, 27 February 2005, *J. Rebman* 10980 (SD 158368); Walker Canyon Ecological Reserve (CAF&G) between Boulevard and Jacumba, N side Interstate 8, E side of Reserve, 32.6614°N, 116.2089°W, 22 March 2005, *J. Rebman* 11389 (SD 158877, SD 159329, UCR); Cleveland National Forest, Poser Mountain, NE of Alpine and Viejas Indian Reservation, N of Old Viejas Grade Road, 32.8694°N, 116.6739°W, 19 April 2007, *J. Rebman* 13114 (SD 175765); Potrero Peak, N of Tecate, 32.6241°N, 116.6271°W, 4 May 2007, *J. Rebman* 13330 (SD 175766); Barrett Lake, S of dam, E of Barrett Lake Road, 32.6786°N, 116.6714°W, 8 May

2007, *J. Rebman* 13488 (SD 175767); Campo, May 1916, *F. Stephens s.n.* (SD 9353); near Campo, 30 December 1922, *I. Wiggins* 1045 (DS 506985, POM 180494); Kitchen Creek 4 mi N of Cameron, 32°45'N, 116°27'W, 3 October 1971, *H. Witham* 1608 (SD 83813); 11 mi SW of Campo, Hwy. 94, T18S R3E S13, 27 May 1982, *G. Yatskievych* 82-166, (ASU 126433). MEXICO, STATE OF BAJA CALIFORNIA (=Baja California Norte): About 5 mi SW of river at Rancho Mike between Highway 3 and Parque Nacional Sierra de San Pedro Martir, 22 May 1981, *T. F. Daniel* 1529 (ASU 116042); Sierra Blanca (based on R. Moran's subsequent correction in field notes; original label states Cerro Blanco as locality), NW slope, 32°3.5'N, 116°31'W, 24 May 1970, *R. Moran* 17577 (SD 75789); Kumeyaay Ranch of Ha-a, 25 km ± SE of Tecate, 32°22'N, 116°30'W, 10 October 1976, *R. Moran* 23777 (SD 97390).

*Latin Diagnosis:* *Pentagramma triangularis* (Kaulfuss) Yatskievych, Windham, & E. Wollenweber subsp. *semipallida* (J. T. Howell) Yatskievych, Windham, & E. Wollenweber simile, sed farina sparsa alba in adaxiali pagina laminae.

*English Diagnosis:* Similar to *Pentagramma triangularis* (Kaulfuss) Yatskievych, Windham, & E. Wollenweber subsp. *semipallida* (J. T. Howell) Yatskievych, Windham, & E. Wollenweber, but with scattered, white farina on the adaxial blade surface.

**Rhizome** decumbent, occasionally erect; densely covered with glossy, narrowly triangular to linear, fibrillose (*sensu* Lellinger 2002) (Fig. 3B), bicolorous scales, amber with a dark red-brown central, vertical stripe (Figs. 3A, B). **Fronds** (Fig. 1A), few to many (4–37+) per plant, 5–36 cm long, 3–14 cm wide. **Stipe** 3–28 cm long, slender (Fig. 1C), 0.25–1.75 mm wide, glossy red-brown (Fig. 3E), aging dull, dark red-brown; terete with a single, V-shaped vascular bundle (Fig. 3D), sparse white farina throughout, more dense proximally and distally, not viscid-glandular, with proximal rhizome-like or clathrate, lance-ovate scales (*sensu* Lellinger 2002), some scales at mid-stipe more deltoid-ovate either bicolorous amber with a dark red-brown mid-stripe, a dark red-brown apex (Fig. 3C), or concolorous amber. **Blade** (delineates everything above the stipe) herbaceous to somewhat coriaceous, deltoid-pentagonal (Fig. 1C), bipinnate-pinnatifid, the two basal pinnae subsessile (Figs. 1A, C), the proximal basispic lobes of basal pinnae deeply pinnate-pinnatifid (pedate, *sensu* Lellinger 2002), the proximal acroscopic lobes of basal pinnae shallowly pinnatifid to crenate (Fig. 1C), pinnule margins entire to somewhat crenate, sometimes slightly revolute (occasionally involute but possibly due to drying); adaxial surface green, not viscid-glandular, with sparse to moderately dense white farina



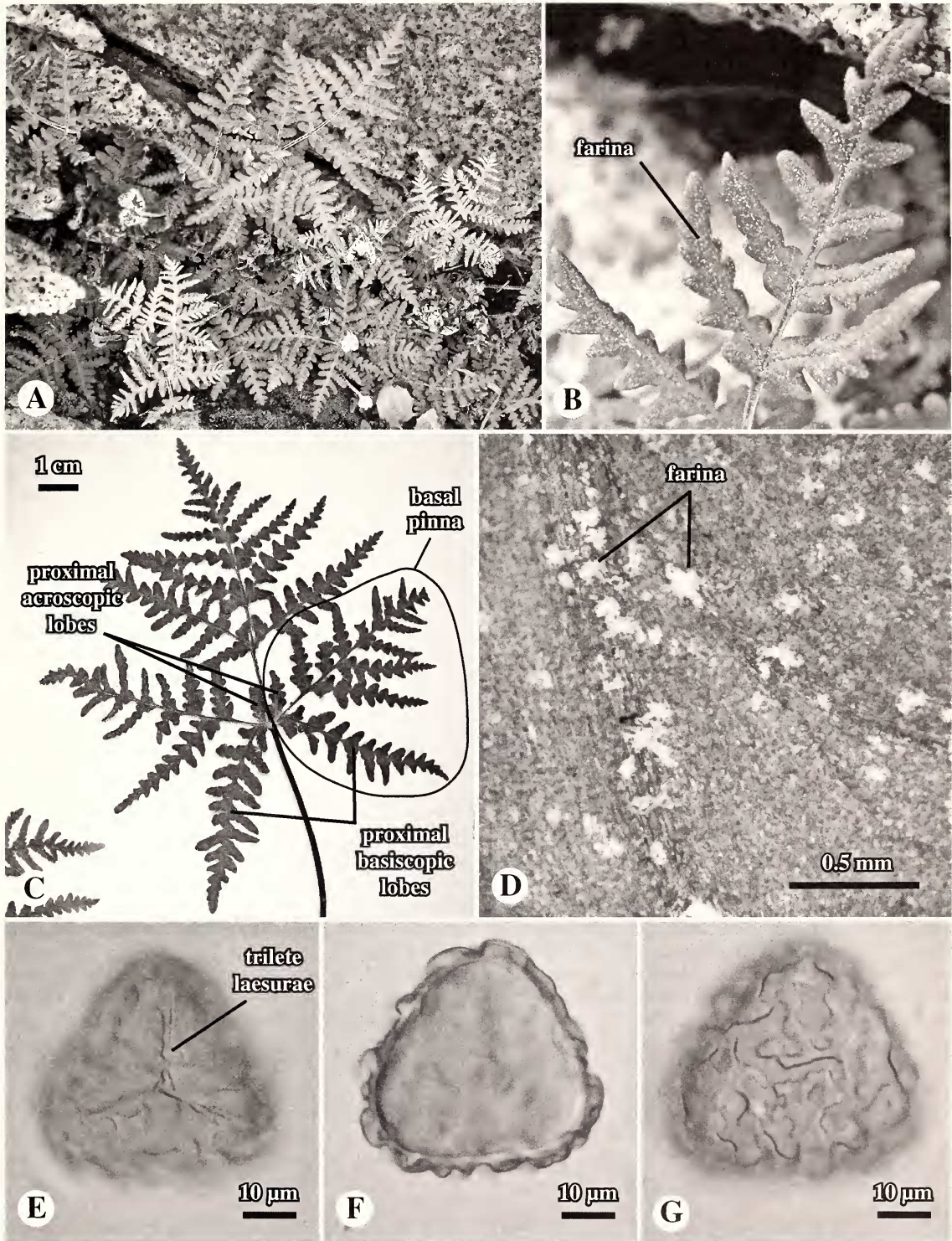


FIG. 1. A–B. *Pentagramma triangularis* subsp. *rebmanii*, growing in cracks of granitic boulders. Note scattered, adaxial farina. C. Blade of *P. t.* subsp. *rebmanii* (holotype: SD 159328, *J. Rebman 11483 & G. Bustillos*), showing acroscopic and basiscopic pinnae. D. Close-up of adaxial surface of “C” showing farina. E–G. Differential interference contrast images of spore from holotype. E. Proximal surface, with trilete laesurae. F. Median optical section showing wall structure. G. Distal view showing merging tuberculate-rugulose sculpturing.

primarily along veins and rachis (Figs. 1B, D); abaxial surface moderately to densely white farinose. **Sporangia** 146–209  $\mu\text{m}$  wide by 173–255  $\mu\text{m}$  long, exindusiate; mature sporangium annulus dark amber. **Spores** 64 per sporangium, mean diameter per population examined 38.9–43.7  $\mu\text{m}$  [absolute range 23.9–50.4  $\mu\text{m}$ ] tetrahedral, concolorous, tan, trilete, laesurae flush (Fig. 1E); wall sculpturing tuberculate-rugulose, with tubercles merging (Figs. 1F, G). Chromosome number unknown.

**Distribution and Habitat.** Native to a restricted geographical range of south-central to southeastern San Diego County, California, and inland, northwestern Baja California, Mexico, 33°02' to 31°01'N, 116°44' to 115°40'W. Occurring in chaparral, riparian-oak woodland, and desert transition communities on shaded slopes beneath rock outcrops with seasonal dripping water, in cracks and at the base of granite boulders, on granitic derived substrates of slope drainage streams, and on damp gabbro soils; elevation 450–1250 m; in association with *Cheilanthes clevelandii* D. C. Eaton, *Epipactis gigantea* Hooker and *Lilium humboldtii* Roetzl and Leichlin subsp. *ocellatum* (Kellogg) Thorne, *Pellaea mucronata* (D. C. Eaton) D. C. Eaton subsp. *mucronata*, *Pentagramma triangularis* subsp. *triangularis*, *Selaginella bigelovii* L. Underwood, and *Woodwardia fimbriata* Smith.

**Phenology.** Dependent upon winter rains to support both spore germination and new crozier growth from perennial rhizomes; sporangia mature in late winter and throughout the spring, persistent on completely desiccated specimens.

**Etymology.** This new subspecies is named in honor of Dr. Jon P. Rebman, Curator of Botany, San Diego Natural History Museum, who originally recognized that this subspecies differs from other *Pentagramma* taxa. Dr. Rebman is an outstanding taxonomist and an expert on the Cactaceae of Lower California and the flora of Southern California and Lower California. His extensive field studies of the flora of the Californias have resulted in the description of several new species from Baja California and Baja California Sur, Mexico.

**Common Name.** Rebman's Silverback Fern

## DISCUSSION

*Pentagramma triangularis* subsp. *rebmanii* is a new silverback fern currently known only from south-central to southeastern San Diego County, California and inland, northwestern Baja California, Mexico. It is similar to the other subspecies assigned to *P. t.* (Yatskievych et al. 1990) in having sharply bicolorous rhizome scales (Fig. 3A, B); terete, slender, glossy, red-brown stipes (Fig. 3E) with a single, V-shaped vascular bundle (Fig. 3D); blades with a strongly deltate-

pentagonal shape and sessile to adnate pinnae (Fig. 1C); and spores that are uniformly tan, coarsely tuberculate with tubercles fused and appearing somewhat rugulose, lacking equatorial ridges (Figs. 1E–G). In addition, subspecies *rebmanii* has the abaxial, dense white farina typical of *P. t.* subspecies *maxonii* (Weatherby Yatskievych, Windham, & E. Wollenweber, subspecies *viscosa* (Nuttall ex D. C. Eaton) Yatskievych, Windham, & E. Wollenweber (Weatherby 1920), and *semipallida* (Yatskievych and Windham 1993).

*Pentagramma triangularis* subsp. *rebmanii* generally has smaller mean spore diameter than other subspecies of *P. triangularis*. The range of the mean diameter for three different spore measurements from the holotype is 34.1–38.9  $\mu\text{m}$  (total range of all spores measured for these three specimens equals 32.3–47.8  $\mu\text{m}$ ); the mean range of a total of seven specimens of subspecies *rebmanii*, including the three holotype measurements, was 38.9–43.7  $\mu\text{m}$  (total range of all spores measured of these seven specimens equals 23.9–50.4  $\mu\text{m}$ ). This spore diameter overlaps only within the low values of the range for diploid populations of other *P. t.* taxa (Ault and Grant 1960; Smith et al. 1971). In contrast, tetraploids of other *P. t.* taxa had significantly larger spore diam. (Smith et al. 1971). A later study (Smith 1980) correlated farina flavonoid analysis with known cytological analysis (Table 1). Based upon spore measurements and flavonoid analysis, there appears to be no evidence for polyploidy in subsp. *rebmanii*.

Subspecies *rebmanii* differs from all other subspecies of *P. t.* in having scattered, white farina on the adaxial blade surface (Fig. 1B, D, 2E), and lightly scattered along the stipe (Fig. 3E). It further differs from subspecies *maxonii* in lacking the distinctive yellow capitate glands on the adaxial blade surface (Fig. 2A), and from *viscosa* in lacking the viscid-resinous adaxial blade surface (Fig. 2D) and entire margins on the distal and basiscopic lobes of the basal pinnae. The other two subspecies, *semipallida* (Fig. 2B) and *triangularis* (Fig. 2C), have a glabrous adaxial blade surface (Yatskievych and Windham 1993); subspecies *triangularis* has yellow abaxial farina, and subspecies *semipallida* has a thicker stipe, a more coriaceous dark green blade, and white abaxial farina. (Mickel and Smith 2004 treat subspecies *semipallida* as a synonym of subspecies *triangularis*.) A key to the taxa of *Pentagramma* occurring in California and Baja California, Mexico is provided below.

The new taxon is superficially similar to *Pentagramma pallida* (Weatherby Yatskievych Windham, & E. Wollenweber in having farina on the adaxial blade surface (Fig. 2F, 3G). However, *P. pallida* differs in having a black, very glandular-farinose stipe throughout (Fig. 3H);



TABLE 1. *PENTAGRAMMA TRIANGULARIS* FLAVONOID AND CYTOLOGICAL ANALYSES. <sup>1</sup>Smith 1980, <sup>2</sup>Wollenweber personal communication, <sup>3</sup>Wollenweber & Dietz 1980, <sup>4</sup>Wollenweber & Smith 1981, <sup>5</sup>Wollenweber et al. 1979, <sup>6</sup>Inferred from spore measurements

Subspecies	Flavonoid analysis	Cytological analysis
<b>maxonii</b>	Major: Galangin <sup>3</sup>	Diploid <sup>1</sup>
<b>rebmanii</b>	Major: 2',6'-dihydroxy-4',4-dimethoxy dihydrochalcone <sup>2</sup> Minor: 2',6',4-trihydroxy,4'-methoxy-3'-methyl dihydrochalcone <sup>2</sup> Trace: Kaempferol-4'-methyl ether <sup>2</sup> (on one of two specimens analyzed)	Diploid <sup>6</sup>
<b>semipallida</b>	Major: Kaempferol 3,4'-dimethyl ether <sup>1</sup>	Diploid <sup>1</sup>
<b>triangularis</b>	Major: Ceroptin <sup>4</sup> (Holotype) Galangin 7-methyl ether <sup>1</sup> Kaempferol <sup>1</sup> Kaempferol-4'-methyl ether <sup>1</sup> Kaempferol-4' methyl ether and 7,4'-dimethyl ether <sup>1</sup>	Diploid and Tetraploid <sup>1</sup> Tetraploid <sup>1</sup> Tetraploid <sup>1</sup> Diploid <sup>1</sup> Tetraploid <sup>1</sup>
<b>viscosa</b>	Major: 2',6',4-trihydroxy,4'-methoxy-3'-methyl dihydrochalcone <sup>5</sup> Minor: 2',6'-dihydroxy-4',4-dimethoxy dihydrochalcone <sup>2</sup>	Diploid <sup>1</sup>

a more compact, less deltoid blade (Fig. 3G), and an adaxial blade surface that appears grayish due to the dense farina and associated, numerous globose glands (Fig. 2F, 3G). In contrast, *P. triangularis* subsp. *rebmanii* has a red-brown stipe (Fig. 3E) lightly scattered with white farina, a more open deltoid-pentagonal blade (Fig. 1C), and green adaxial surface (Fig. 3F) with scattered white farina (Figs. 1B, D, 2E).

*Pentagramma triangularis* subsp. *rebmanii* is found in a very narrow north-south range from a site in the Cleveland National Forest (SD 175764), San Diego County, California, approximately 52 km north of the U.S.-Mexico border to a site in northwestern Baja California (ASU 116042) and approximately 180 km south of the U.S.-Mexico border, and an east-west range of approximately 100 km between Bratton Valley (SD 175857) and the latter Baja California site (Fig. 4), the range approximately 12,000 km<sup>2</sup>. This includes the dry inland foothill and mountain transition area between the coast and high Anza-Borrego Desert in San Diego County and the dry inland coastal scrub and foothills of northwestern Baja California that are so dependent upon the scarce winter rains to encourage growth of the native flora. Two of our San Diego County specimens are from locations completely burned during the 2003 Cedar fire; SD 157261 from chaparral and oak woodland on Viejas Mountain (growing with *Adenostoma fasciculatum* Hooker, *Epipactis gigantea*, *Lilium humboldtii* subsp. *ocellatum*, *Mimulus cardinalis* Benth., *Platanus racemosa* Nuttall, *Quercus agrifolia* Nee, and *Woodwardia fimbriata*) and SD 175765 from chaparral on Poser Mountain (growing with *Adenostoma fasciculatum*, *Ceanothus oliganthus* Nuttall, *Cercocarpus betuloides* Torrey and A. Gray, *Heteromeles arbutifolia* (Lindley) Roemer, and *Mimulus clevelandii* Bran-degee).

Farina flavonoid analyses indicate that *P. pallida*, a diploid species containing the C-methylated flavonones cryptostrobin, strobopinin, and desmethoxyxymatteucinol (Wollenweber and Dietz 1980; Smith 1980), is quite distinct from *P. triangularis*. Further studies documented distinctive flavonoid patterns in each of the *P. triangularis* subspecies (Table 1). The major exudate component of subsp. *rebmanii*, 2',6'-dihydroxy-4',4-dimethoxy dihydrochalcone (Wollenweber personal communication), was previously reported (Wollenweber and Dietz 1980) as abundant on *Pityrogramma calomelanos*, *P. dealbata*, *P. tartarea*, and *P. trifoliata*; this same exudate was noted also as a trace constituent on a single population of *Pentagramma triangularis* var. *triangularis* [= *Pentagramma t.* subsp. *t.*] (Wollenweber et al. 1985) from northern California. The minor constituent in the farina of subsp. *rebmanii* is the same as the major flavonoid found in the exudate of *Pityrogramma triangularis* var. *viscosa* [= *Pentagramma t.* subsp. *v.*] (Wollenweber et al. 1979, Wollenweber personal communication) and vice versa. In addition, traces of kaempferol-4'-methyl ether (Wollenweber personal communication) were identified in one of two specimens of subsp. *rebmanii*; this compound was found also in some subspecies *triangularis* specimens that do not produce ceroptene (Smith 1980; Wollenweber et al. 1985). Thus, subsp. *rebmanii* exhibits only minor or trace similarities to the *P. t.* group. Interestingly, the new taxon is chemically more similar to species of *Pityrogramma* than to specimens of *Pentagramma triangularis* studied so far.

*Pentagramma triangularis* subsp. *rebmanii* is readily distinguishable in the field from the other subspecies by using a hand lens to observe the adaxial white farina, which appears as amorphous, mealy deposits (Figs. 1B, D).



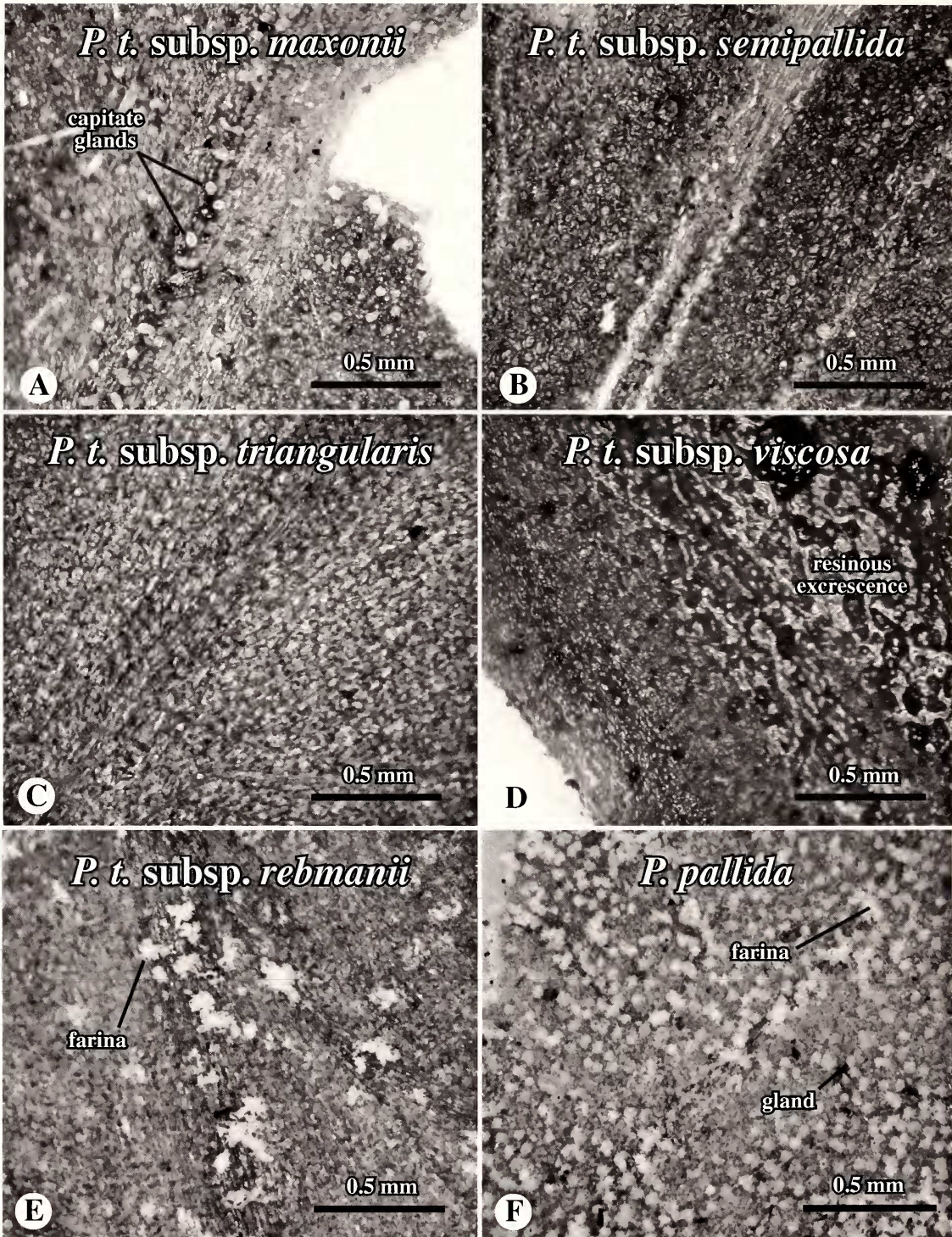


FIG. 2. Close-ups of adaxial blade surface of *Pentagramma* species and subspecies, showing excrecence variation. A. *P. triangularis* subsp. *maxonii* (SD 163900) with capitate glands. B. *P. t.* subsp. *semipallida* (SD 115777) lacking adaxial excrecence. C. *P. t.* subsp. *triangularis* (SD 161665) lacking adaxial excrecence. D. *P. t.* subsp. *viscosa* (SD 100692) with resinous excrecence. E. *P. t.* subsp. *rebmanii* (SD 159328) with scattered farina. F. *P. pallida* (ASU 124800) covered with farina and associated globose glands.



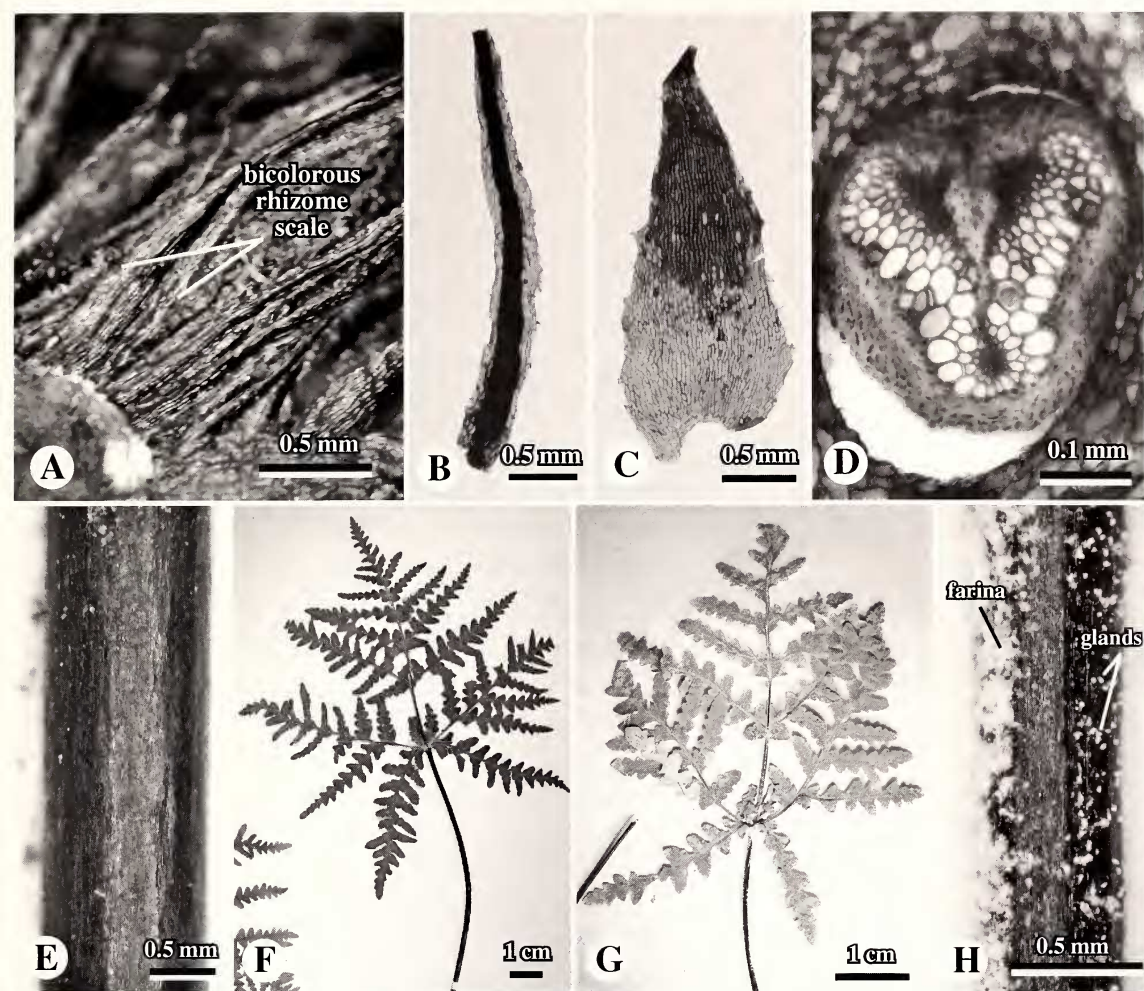


FIG. 3. A–F. *Pentagramma triangularis* subsp. *rebmanii* (holotype: SD 159328, *J. Rebnan* 11483 & *G. Bustillos*). A–B. Rhizome scales, bicolorous and fibrillose. C. Clathrate scales from mid-stipe region with darkened apex. D. Stipe cross-section showing single vascular bundle (xylem V-shaped), adaxial side at top. E. Stipe surface, glossy red-brown with sparse farina, at mid-region. F. Blade, adaxial surface with scattered farina. G–H. *P. pallida* (ASU 124800). G. Blade adaxial surface covered with farina and associated globose glands. H. Stipe surface, dull blackish with glandular-farinaceous deposits, at mid-region.

KEY TO THE *PENTAGRAMMA* TAXA OF CALIFORNIA AND BAJA CALIFORNIA, MEXICO

- 1. Blade adaxial and abaxial surfaces white farinose
  - 2. Stipe dull purplish-black to black, with moderately dense, grayish-white farina along entire stipe length; blade adaxial surface with overall grayish appearance . . . . . *Pentagramma pallida*
  - 2'. Stipe glossy red-brown aging dull, dark red-brown, with lightly scattered white farina; blade adaxial surface green . . . . . *Pentagramma triangularis* subsp. *rebmanii*
- 1'. Blade adaxial surface viscid-resinous, glabrous, or with scattered yellow capitate glands; abaxial surface white or yellow farinose
  - 3. Blade adaxial surface viscid-resinous, distal pinnae and proximal basiscopic lobes of basal pinnae mostly entire . . . . . *Pentagramma triangularis* subsp. *viscosa*
  - 3'. Blade adaxial surface glabrous, or with scattered yellow capitate glands, distal pinnae and proximal basiscopic lobes of basal pinnae deeply pinnate-pinnatifid
    - 4. Blade adaxial surface with scattered yellow capitate glands. . . . . *Pentagramma triangularis* subsp. *maxonii*
    - 4'. Blade adaxial surface glabrous
      - 5. Blade abaxial surface white farinose . . . . . *Pentagramma triangularis* subsp. *semipallida*
      - 5'. Blade abaxial surface yellow farinose . . . . . *Pentagramma triangularis* subsp. *triangularis*

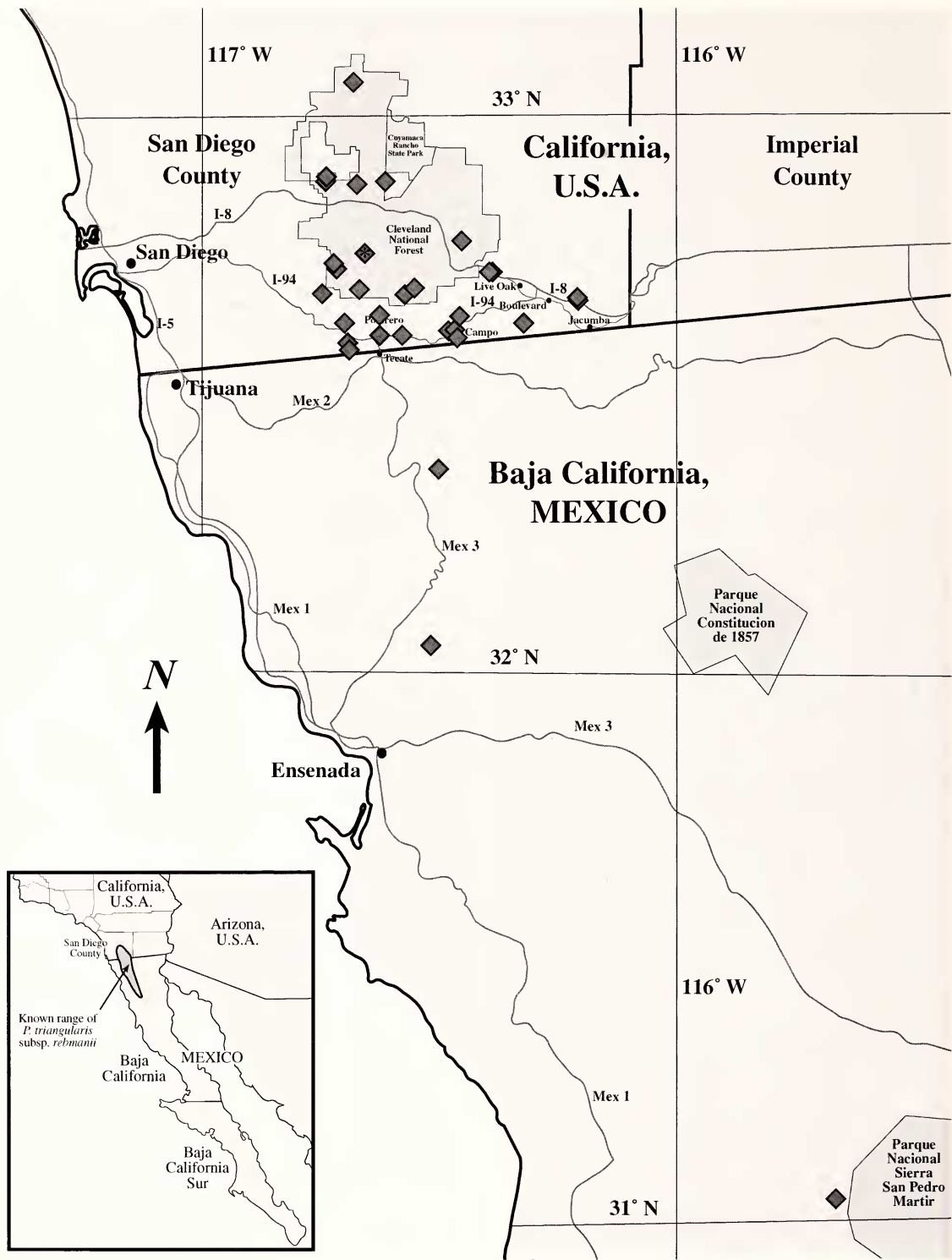


FIG. 4. Localities for collections of *Pentagramma triangularis* subsp. *rebmanii*, to date known only from south-central to southeastern San Diego County, California, USA, and inland, northwestern Baja California, Mexico. \*=holotype locality.



## ACKNOWLEDGMENTS

We would like to express our gratitude to Dr. Jon Rebman for initially pointing out the distinctiveness of this new subspecies and to Jeannie Gregory for photographs shown in Figs. 1A, B. We thank Dr. George Yatskievych for encouraging study of this new taxon and Dr. Eckhard Wollenweber for farina analysis. We express our appreciation to Dr. Exequiel Ezcurra and Krista Pelayo for Spanish translation; and to Ruth Kirkpatrick, John Hunter, and two anonymous reviewers for their constructive critique of this manuscript. We thank ASU, CAS-DS, RSA-POM, UC-JEPS, and US herbaria for *Pentagramma* specimen loans.

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